

NATIONAL GRASSLANDS SWIFT FOX REPORT, 1999

Pawnee National Grasslands Swift Fox report 1999

Mark Ball

The Pawnee ran three consecutive nights of swift fox spotlight surveys. At least six hours of survey time were spent for each night of Sept 20, 21, & 22. A passing cold front was thought to effect the number of sightings the first two nights. A return to warmer, drier conditions on the third night resulted in sighting numbers similar to results under those conditions in previous years. Seven confirmed and two unconfirmed the first night; Twelve confirmed and one unconfirmed the second night; Twenty-six confirmed and two unconfirmed the third night.

Fort Pierre National Grasslands report 1999

Glenn Moravek

No formal surveys were completed. Not aware of any Swift fox on the Fort Pierre National Grasslands.

Ogalala National Grasslands report 1999

Jeff Abegglen

No formal surveys were completed. Not aware of any Swift fox on the Ogalala National Grasslands.

Thunder Basin National Grasslands report 1999

Tim Byer

No formal surveys were completed. It is assumed the Swift fox populations on the Thunder Basin National Grasslands are stable.

Cimarron National Grasslands report 1999

Jeff Chynoweth

No formal surveys were completed. It is assumed the Swift fox populations on the Cimarron

National Grasslands are stable.

Comanche National Grasslands report 1999

Jeff Chynoweth

No formal surveys were completed. It is assumed the Swift fox populations on the Comanche National Grasslands are stable.

Buffalo Gap National Grassland report 1999

East ½ Wall Ranger District

No formal surveys were completed. Because Conata Basin is a Black-footed Ferret reintroduction site many hours of spotlighting is being done.

Two swift fox sightings were recorded during Black-footed Ferret surveys – Pennington County.

1. February 26, 1999.
 - a. NENE of Section 14, Township 3 South, Range 16 East. Sighting on a Prairie dog town.
2. January 28, 1999
 - a. NWNE of Section 30, Township 3 South, Range 15E. Tracks in the snow on a Prairie dog town.

West ½ Fall River Ranger District.

Formal surveys were conducted in summer of 1999. See attached report.

The Swift Fox population that lives near Ardmore SD appears to be stable. No other Swift Fox were located.

1999 SWIFT FOX SURVEY, FALL RIVER RANGER DISTRICT BUFFALO GAP NATIONAL GRASSLAND, NEBRASKA NATIONAL FOREST

Lynn Allan Hetlet

INTRODUCTION

Surveys to determine locations of swift fox (*Vulpes velox*) were conducted on the Fall River District of the Buffalo Gap National Grassland from 1989 through 1998. Additional new areas were surveyed in 1999, as well as the only annual route established in 1994 that still shows evidence of a swift fox population.

SURVEY AREAS

The areas of Fall River County previously unsurveyed for swift fox that were surveyed in 1999 total 6,250 acres (Maps 1&2). The established annual route surveyed 2,720 acres (Map 3).

METHODS

Approximately 120 man-hours (including travel time) were spent establishing and utilizing bait stations. A bait station consists of a circular area 18 to 20 inches in diameter cleared of all vegetation. A mixture of fine masonry sand and vegetable oil is spread over the area and smoothed. The mixture consists of one cup of oil to one gallon of sand.

Approximately one-half ounce of jack mackerel is placed in the center of the station to serve as bait. Because of the swift fox's primarily nocturnal habits, the stations are baited during the early evening hours to decrease the time of drying and insure a high degree of scent dispersal.

This sand/oil mixture will hold a track impression quite well, and if insects such as grasshoppers and carrion beetles are not abundant enough to be disturbing the bait and sand, (through either digging or simply hopping through it), it is not necessary to check the sites early, but the slanting light of the early hours greatly facilitates in seeing details in the track.

Bait stations are placed approximately 1/4 mile apart, following ridge tops to give better scent dispersal on the evening downdrafts.

RESULTS AND DISCUSSION

The area newly surveyed in the Edgemont area (Maps 1&2) resulted in tracks of cottontail rabbit at 7 bait stations, striped skunk at 15, jackrabbit at 3, deer at 1, pronghorn at 1, American badger at 1, raccoon at 2, kangaroo rat at 1, and probable juvenile bobcat at 8-- from a total of 75 bait stations-nights. (Tables 1,2).

The annual survey in the Ardmore area (Map 3) resulted in swift fox tracks at 24 bait stations

over the three nights, out of a possible 93 bait station-nights, striped skunk at 1, and American badger at 2 (Table 1). The swift fox tally is down from 34 in 1998, up from 12 in 1997, but still down from the 45-50 for each of the 3 previous years. No swift fox tracks were found in the south half of the area, suggesting that that area is no longer used for denning. No active swift fox dens were found this year.

These results indicate that a population of swift fox is still present in the area, but may be reduced from the levels experienced several years ago. The area has had above normal rainfall for several years with accompanying increased vegetation. This could be a factor in survival due to decreased visibility, and therefore decreased ability to detect predators.

Richard Peterson, working for the South Dakota Department of Game, Fish and Parks in 1999, found swift fox tracks north and east of this survey area, indicating that there may be a larger population of swift fox, primarily on private ranchland.

Bait Station	Day 1	Day 2	Day 3
1	MEME		
2			
3			
4	TATA		
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17		TATA	
18			
19			
20			VUVE
21		VUVE	VUVE
22		VUVE	VUVE
23		VUVE	VUVE
24		VUVE	VUVE
25	VUVE	VUVE	
26		VUVE	VUVE
27		VUVE	VUVE
28	VUVE	VUVE	VUVE
29	VUVE	VUVE	VUVE
30	VUVE	VUVE	VUVE
31			

Table 1. Track on Ardmore Area swift fox survey route (Map 1) August 17, 18, 19, 1998.

VUVE - swift fox

TATA - American badger

MEME - striped skunk

Bait Station	Day 1	Day 2	Day 3
1			
2			
3		SYSP	
4			
5			
6	SYSP	SYSP	
7			
8		DIOR	
9			
10			
11			
12			
13	CALA		
14		SYSP	
15			
16			
17			
18			
19			
20			
21			
22		LETO	
23			
24	MEME		
25	MEME		

Table 2. Tracks on Edgemont survey area (North area) (Map 2) August 3, 4, 5, 1999.

MEME - striped skunk

LETO - white-tailed jackrabbit

SYSP - cottontail species

CALA - coyote

DIOR - Ord's kangaroo rat

Bait Station	Day 1	Day 2	Day 3
1			SYSP
2		MEME	
3			
4	ANAM		
5	SYSP	ODSP	
6			
7			
8			
9			
10			
11	MEME		
12	LETO		
13			
14	MEME	MEME	
15		MEME	MEME
16	MEME	MEME TATA	MEME,FESP
17		LETO	
18			PRLO
19			PRLO
20	SYSP		
21		FESP	FESP,SYSP,MEME
22	MEME	MEME	FESP
23		FESP	FESP
24	MEME,SYSP,FESP	FESP	FESP
25			

Table 3. Tracks on Edgemont survey area (South area) (Map 3) August 10, 11, 12, 1999.

MEME - striped skunk

TATA - American badger

SYSP - cottontail species

ANAM - pronghorn antelope

LETO - white-tailed jackrabbit

PRLO - raccoon

ODSP - deer species

FESP - cat species, probably juvenile bobcat

1999 ANNUAL REPORT, PRELIMINARY REPORT TO THE SWIFT FOX
CONSERVATION TEAM: HISTORIC AND RECENT DISTRIBUTION OF SWIFT FOXES
IN NORTH AMERICA

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INTRODUCTION

The swift fox was first described by Say in James (1823). Say named the fox *Canis velox*, but it was reassigned to the genus *Vulpes* by Audubon and Bachman (1851). Soon afterwards, Merriam (1888) described and named the kit fox (*Vulpes macrotis*). Hall and Kelson (1959) suggested that swift foxes and kit foxes were conspecifics; being subspecifically distinct. Similar conclusions were reported by Dragoo et al. (1990) using morphometric analysis coupled with electrophoretic protein analysis. However, multivariate morphologic analysis has distinguished swift and kit foxes (Rohwer and Kilgore 1973, Thorton and Creel 1975, Egoscue 1979, McGrew 1979, Stromberg and Boyce 1986). The most recent evaluation of taxonomic status, using mitochondrial DNA restriction-site and sequence analyses concluded that the kit fox and the swift fox should be recognized as separate species (Mercure et al. 1993). For the purposes of this report, we will consider the swift fox as a separate species from the kit fox.

The swift fox is native to the shortgrass and mixed-grass prairies of the Great Plains Region of North America (Egoscue 1979). The historic range of the swift fox includes all or portions of North Dakota, South Dakota, Montana, Nebraska, Wyoming, Colorado, Kansas, Oklahoma, New Mexico, and Texas and the southern prairie region of Alberta, Manitoba, and Saskatchewan (Hall and Kelson 1959, Egoscue 1979, Banfield 1974).

The historic distribution in the Great Plains has been based on the limited information found in museum and fur-trade records and by accounts of early naturalists and explorers as described above. Historic distribution information is especially fragmentary and not all observations are verifiable. In the United States, eastern boundary of the historic distribution of swift foxes remains particularly unclear. This uncertainty may be attributed to the naturally shifting geographical location of the boundary between the mixed-grass and tallgrass prairies; the shifting largely occurred because of climatic variations (Risser et al. 1981, Kuehler 1972, 1985; Weaver et al. 1996). Swift fox distribution in the east may have repositioned with the changing boundary between the regions. Many biologists (Swift Fox Conservation Team 1997) believe that swift fox distribution was influenced by the expanse of shortgrass and mixed-grass prairie (Risser et al. 1981; Fig. 1). This assessment is based on observations of swift fox behaviors, habitat use, and locations of confirmed records. If swift fox historic distribution did conform to the vegetation classification, the swift fox historic distribution may have been 20-25% less than what has been reported in literature (see Swift Fox Conservation Team 1997:2-3). There is a fossil record in eastern Missouri dating 5,478 to 3,478 years BP (Parmalee et al. 1969), a location considerably east of the range now and prior to European settlement. Regarding this record,

Egoscue proposed the potential importance of swift foxes as an indicator species identifying the former extent of shortgrass and mixed-grass prairies, recognizing the strong association of swift foxes with shortgrass and mixed-grass prairie.

The first record of the swift fox is from Alexander Henry's fur shipment records, from the Pembina Post of the Northwest Company's Red River District (northeast North Dakota) in 1801 (Reid and Gannon 1928). Alexander Henry's journals do not identify exact trapping locations, but rather likely reflect where fox pelts were traded. Specifically, there is no mention of swift or kit foxes in Henry's journals, only reference to red foxes. "Kit" (swift) foxes were only noted in tabulation of yearly returns (Reid and Gannon 1928). The small number taken in the eight years of trapping records suggests swift foxes were not common in northeastern North Dakota during Henry's operation at the Pembina Post. Moreover, Reid and Gannon suggest that swift foxes likely were not common in northeastern North Dakota, stating "...being a plains animal it is quite probable they were more common farther west." However, Bailey (1926) quotes Charles Cavileer from "A Story of '53" describing the fur-trade in Walhalla, just west of the Pembina Post, as obtaining 400-600 "kit foxes" per year from the Pembina mountain region for a period before the bison disappeared.

Some historical range descriptions include swift fox in Minnesota and Iowa, however, there are no verifiable records of swift fox occurrence in either state (E. Birney, Bell Museum of Natural History, University of Minnesota, personal communication; Dinsmore 1994). Swanson et al. (1945) surmised swift foxes may have occasionally ventured into Minnesota based on their occurrence only 56 km west of Minnesota, as reported in Alexander Henry's journals. Similarly, there are only second hand reports of swift fox observations in Iowa (see Dinsmore 1994). Furthermore, no records of swift foxes have been confirmed for counties in South Dakota or Nebraska adjacent to Iowa.

Bailey and Bailey (1918) reported swift foxes along the foothills of the Rocky Mountains east of Glacier National Park. Hall and Kelson (1959) indicated the range of the species crossed the mountains of western Montana extending into British Columbia. This determination was contradicted by Hoffmann et al. (1969) and Soper (1964), who did not list the species as part of British Columbia's fauna. Banfield (1974) describes Canadian distribution at the time of settlement as the southern prairies of Canada from the Pembina Hills of Manitoba to the foothills of the Rockies.

In Wyoming, historic records define the western edge of distribution along the eastern portions of Big Horn, Washakie, Fremont, and Sweetwater counties (Long 1965, Lindberg 1986). Cary (1911) described accounts of swift foxes as far west as Boulder County in Colorado. In the southern portion of the historical range, in extreme west Texas and New Mexico, the swift fox overlapped with the kit fox, and hybridization apparently occurred along the Pecos River (Hall and Kelson 1959, Rohwer and Kilgore 1973, Mercure et al. 1993). Early accounts suggest swift foxes occupied nearly all of South Dakota and Nebraska and the western two-thirds of Kansas (Egoscue 1979, Hall 1981). They are believed to have occupied the panhandle and the western

portion of the adjacent three counties in Oklahoma (Duck and Fletcher 1945, Hall and Kelson 1959, Caire et al. 1989).

In this report, we provide sources of swift fox records both historic and recent, for each of the states included in the historic range of swift foxes (see Appendix). These records contribute to description of historic range and current distribution of swift foxes which we then use to estimate the proportion of the historic range that is currently occupied. We do not consider this report complete, but rather an evolving document, to be appended to as more information is discovered. To this end, we fully expect future input from state biologists and others to provide additional information and discuss improvements in our approach and presentation. We have contacted museums, state agencies, universities, etc., and used literature to compile these records. At the time of this writing, we are continuing to update the information presented below. Point data for current records are being compiled and will be provided to the team's habitat committee to generate a GIS data base. Our compilation of recent records at the time of this writing is incomplete, with many states yet to provide point data. Development of the data base for swift fox locations will receive the focus of our attention in coming months.

SUMMARY OF SWIFT FOX RECORDS

Colorado

Swift foxes originally occupied the prairies throughout eastern Colorado (Cary 1911, Armstrong 1972, Hall 1981). By the early 1900s, swift fox range had contracted significantly (Cary 1911, Armstrong 1972, Hall 1981), yet Cary (1911) reported that swift foxes were common in many counties. In 1915-1916, swift foxes were collected in Adams (museum records: DMNS1596, DMNS1662, DMNS1667-1669, DMNS1686) and Las Animas (USNM213112, USNM213113, USNM213714) counties, but there was no subsequent documentation in the state until 1941 in Crowley County (BRD101186 [MSB record]). Between 1941 and the early 60s, specimens were collected in Arapahoe, Baca, El Paso, Lincoln, and Prowers counties (see Appendix). Lechleitner (1969) and Armstrong (1972) listed the species as occurring "sparingly" on the eastern plains in the late 1960s.

Annual predator surveys conducted by the U.S. Fish and Wildlife Services' (USFWS) Animal Damage Control Division from 1972-1981 noted stable to slightly increasing populations of the species in the southeastern portion of the state (Linhart 1972, 1973; Roughton 1974, 1975, 1976, 1977; Roughton and Sweeny 1978; Bean and Roughton 1979, 1980; Bean 1981). Documentation increased in recent years (see Appendix) reflecting wide distribution throughout eastern Colorado. Swift foxes are locally abundant in many areas (Zegers 1976, Fitzgerald et al. 1983, Covell 1992, Kitchen 1999). However, Fitzgerald et al. (1983) suggested that distribution of swift foxes may be limited based on absence of swift foxes in readily available and suitable habitats within their study area, the Pawnee National Grassland. This observation may translate to other areas within the range of swift foxes.

Several surveys of various types have been conducted since 1995 in 18 of the 29 counties

in the historic range of swift foxes (Swift Fox Conservation Team 1997, Seidel 1998, Finley 1999); swift foxes were detected in all 18 counties surveyed. This includes 15 counties without documentation of occurrence in years just prior to 1995. Five counties (Adams, Arapahoe, Larimer, Phillips, Sedgwick) within the historic range and with suitable habitat have not been surveyed. Boulder, Douglas, Jefferson, Teller counties, on the western edge of swift fox historic range, are not considered to have suitable habitat remaining to support populations (Swift Fox Conservation Team 1997:50). Kahn and Fitzgerald (1996) indicated a possible increase in swift fox numbers on the Pawnee National Grasslands since 1981. Stable populations have been reported in other studies in several sites in the state (Covell 1992, Finley 1999, Roell 1999).

Iowa

A Holocene fossil record of a swift fox in Plymouth County is reported in Bowles et al. (1998). No verified records exist for presence of swift foxes in Iowa in recent history, although swift fox occurrence in Iowa is indicated in a mammal list (Allen 1942 in Hines 1980) and several range maps (Hall and Kelson 1959, Hawley 1974, Hillman and Sharps 1978, Carbyn et al. 1994). The last unconfirmed sighting of swift foxes was in 1882 in Dickenson County (Dinsmore 1994). Descriptions from sightings may fit the swift fox, but inconsistent use of common names and lack of examined specimen contribute to the confusion (Dinsmore 1994). No record of swift fox exists for counties in South Dakota or Nebraska that are adjacent to Iowa. It is difficult to assess historical distribution of swift foxes in Iowa based on available accounts. Perhaps historically swift foxes occurred intermittently and in low densities in western Iowa.

Kansas

In Kansas, swift fox historical distribution was in at least 36 counties and perhaps 44 counties (including verified and unverified records) throughout the western half of the state; in the shortgrass and mixed-grass prairie habitat (Carter 1939 in Zumbaugh and Choate 1985, Hall and Kelson 1959, Bee et al. 1981, Zumbaugh and Choate 1985, Fox and Roy 1995). Zumbaugh and Choate (1985) provided evidence that swift foxes were extremely abundant in the mid-1800s, but were becoming less abundant by the turn of the century (Knox 1875, Baker 1889, Lantz 1905). The decline continued and by the 1930s the species was believed to have been extirpated from the state (Black 1937, Cockrum 1952, Hall 1955). Sporadic reports continued for the 1930s (Carter 1939, Tihen and Sprague 1939), and no records exist for the 1940s.

The start of swift fox recovery in Kansas was evidenced in the 1950s (Martin and Sternberg 1955, Hibbard and Taylor 1960, Janes and Gier 1966), and by 1981 the species was considered common again in much of western Kansas (Zumbaugh and Choate 1985). This rebound was based on information from road kills and field observations of the species (Zumbaugh and Choate 1985, Fox 1991). During 1982-1983 Zumbaugh and Choate (1985) collected 215 specimens from 12 counties. This rapid unassisted recovery caused Zumbaugh and Choate (1985) to surmise that the swift fox was probably never entirely extirpated from Kansas.

Swift foxes are currently present throughout most of their historic range in Kansas and

have maintained a stable population for the past 20 years (Fox and Roy 1995). In 1997 and 1998, Kansas biologists began a test of a new method for determining swift fox distribution using track searches. In 1997 the track surveys were conducted in 271 townships within a 23 county area (Roy et al. 1997). Adverse weather prevented surveys in one county and part of another county. Swift foxes were detected in 40.5 percent of these townships and in 17 of the 22 counties all or partially searched. Although swift foxes went undetected in the surveys of three other counties (including 2 not searched) during the 1997 survey, one or two road kills were incidentally reported in each of these three counties in 1997. In 1996, an annual summer roadside survey of furbearers also identified swift foxes in these three counties, further verifying presence. In 1998, six additional counties were added to the survey and 245 townships were searched for swift foxes (Roy et al. 1998). Swift foxes were detected in an additional 26.1 percent of the townships, and surveys also confirmed swift fox presence in the three counties where only road kills had previously been reported. Since 1995, swift foxes have been detected by surveys in 30 of the 44 counties in the historic range, but 10 of these counties have not been searched (Roy et al. 1998).

The swift fox has been classified as a furbearer in Kansas since 1982, when a fur harvest season on the swift fox was instituted (Fox and Roy 1995). Harvest data collected since 1982, coupled with limited roadside surveys initiated in 1986, suggested swift fox populations are generally stable (Fox and Roy 1995).

Minnesota

Despite a complete absence of even unconfirmed sightings in the literature, Minnesota has been included in the historic range of the swift fox (Hall and Kelson 1959, Hawley 1974, Hillman and Sharps 1978, Egoscue 1979, Hazard 1982, Carbyn et al. 1994). These inclusions of Minnesota as part of swift fox historic distribution are possibly based on a statement in Swanson et al. (1945) suggesting that since the swift fox is found throughout North Dakota, it "...occasionally ventured into Minnesota." There are no records of swift foxes in Minnesota (E. Birney, Bell Museum of Natural History, University of Minnesota, personal communication). Historically, Minnesota may have been on the fringe of swift fox range, with foxes venturing into the state intermittently and at low densities.

Montana

Historically, the swift fox was considered common in the shortgrass to mixed-grass prairies east of the Rocky Mountains of Montana (Swift Fox Conservation Team 1997, Knowles et al. In press). Lewis and Clark observed swift foxes along the Marias and Missouri Rivers in 1805 and 1806 (Burroughs 1961). In the late 1800s, Coues (1878) reported that swift foxes were common between the Milk River and the Canadian border. There are many other reports of swift foxes in late 1800s and early 1900s (e.g., Audubon and Bachman 1854, Allen 1874, Custer 1875, McChesney 1979; see Knowles et al. In press). The last historical record of swift foxes in Montana was in 1918, when Bailey and Bailey (1918) noted the swift fox commonly occurring on the plains along the eastern edge of Glacier National Park. However, the lack of confirmed records since Bailey and Bailey (1918) and no records of swift fox occurrence in 16 years of fur harvest data prompted Hoffmann et al. (1969) to declare the species extinct in Montana. Annual

predator surveys conducted in Montana by the USFWS's Animal Damage Control Division from 1972-1981 did not note any swift fox visits (Linhart 1972, 1973; Roughton 1974, 1975, 1976, 1977; Roughton and Sweeny 1978; Bean and Roughton 1979, 1980; Bean 1981).

In 1978, the first swift fox specimen in 60 years was collected in Custer County in southeastern Montana (Moore and Martin 1980). There have been numerous confirmed locations of swift foxes throughout the 1980s and especially the 1990s, including observations in 13 counties (Giddings and Knowles 1995:106), but some observations cannot be verified.

Surveys using livetraps were conducted by the Montana Fish, Wildlife and Parks beginning in 1996 and continued in 1997 with efforts focused primarily in Blaine County in north central Montana (Giddings and Zimmerman 1996, Zimmerman and Giddings 1997). Limited live trapping efforts were conducted in Phillips and Valley counties, also located in north central Montana. Occurrence of swift fox was confirmed in the three counties during these survey efforts, and dispersing swift fox from the Canadian reintroduction program have also been identified in these three north-central counties. Incidental sightings of swift fox in four additional counties (Custer, Dawson, Prairie, Garfield) are considered confirmed (Giddings and Knowles 1995, Giddings and Zimmerman 1996). Additional sightings were reported from Cascade, Chouteau, and Pondera counties (Giddings and Zimmerman 1996), Glacier, Hill, McCone, Park, Powder River, and Rosebud counties (Knowles et al. in press), and Golden Valley counties (USFWS 1990).

A swift fox reintroduction on the Blackfeet Nation's Reservation in Glacier County began in 1998 (Giddings 1998). The effort was funded by Defenders of Wildlife. The reintroduction effort continues through 2000 (C. Smeeton, Cochrane Wildlife Reserve, Cochrane Alberta, personal communication).

Nebraska

The swift fox was thought to occur in much of Nebraska prior to European settlement (Jones 1964, Hines and Case 1980, Hall 1981). However, much of the far eastern portion of Nebraska was considered tall grass prairie (Risser et al. 1981) which is inconsistent with habitat typically occupied by swift foxes. Jones (1964) suggested that the swift fox may have been extirpated from Nebraska by the early 1900s because there were no records from 1900-01 (Cary MS in Jones 1964, Cary 1902; records from Antelope, Cherry, Dawes, Madison, and Sioux) to 1953-54 when a female and two pups were taken in Morrill County near Bridgeport (Jones 1964). A road killed (adult female) was found in McPherson County in 1966 (Blus et al. 1967, Lock 1980) and one was trapped somewhere in Nebraska in 1970 (Hawley 1974); additional sightings followed in the 1970s from Box Butte, Dawes, Kimball, Red Willow, Sheridan, and Sioux counties (McDaniel 1975, Lock 1980). By 1980, Hines projected the most probable current distribution of the species in Nebraska to be the western one-fifth of the state. R. Lock (Nebraska Game and Parks Commission, personal communication 1992 reported the in USFWS 1995) indicated the presence of five small, disjunct populations in Sioux, Dawes, Box Butte, Kimball, and Perkins counties of western Nebraska. Specific information on these populations

was limited, however, Mr. Lock judged that at best populations were marginally stable to declining.

Trapping records indicated swift foxes occurred in reasonable numbers in Sioux County (Andelt 1996). Road killed foxes and observations were recorded in the 1990s from Box Butte, Dawes, Kimbal, and Sioux counties (unpublished report of the National Grasslands; Andelt 1996, 1997, 1998; Swift Fox Conservation Team 1997:49). Surveys have been conducted in Chase, Dawes, Dundy, Perkins, and Sioux counties after 1995, with foxes recorded in Perkins and Sioux counties.

New Mexico

Swift foxes likely occurred in 12 counties including Colfax, Union, Mora, Harding, San Miguel, Guadalupe, Quay, De Baca, Curry, Roosevelt, Chaves, and Lea (Swift Fox Conservation Team 1997); vegetative classification was Plains-Mesa Grasslands (Dick-Peddie 1993). Bailey (1931), Egoscue (1979), and Hall (1981) described the species as occurring east of the Pecos River drainage in the extreme eastern portion of New Mexico. There are no records from 1894 to 1952, except a report from Santa Rosa labeled *V. macrotis*, which Bailey (1931) believed was *V. velox*; and a museum record (MSB-#BRD101289) from a fox collected 8 mi southwest of Albuquerque which is substantially removed from the accepted historic range of swift foxes. Further examination of this specimen has identified the specimen as *V. velox* (Robert Harrison, University of New Mexico, personal communication). Hubbard's (1994) report substantiated that the swift fox was probably rare in the state from 1850 through the 1950s and then began to gradually increase in abundance. The report notes that 23 specimens of swift fox were collected during the period of 1952-1968. Thompson et al. (1992) reported swift foxes in 18 counties from museum collections and/or reports in literature, however, 6 of these counties (Dona Ana, Eddy, Lincoln, Luna, McKinley) are beyond the accepted swift fox historic range. These specimens could be kit foxes, but we were unable to confirm their identification. Harrison and Schmitt (1997) surveyed for foxes throughout the historic range using scent-stations and spotlighting; and they examined fur harvest records. They confirmed the occurrence of swift fox in 11 counties within the 12-county historic range. However, there are large areas of 6 counties along the western most edge of the current distribution area which are not suitable swift fox habitat. Researchers in New Mexico have also indicated that there may be a gap between swift fox populations in the northern and southern portions of the state. Swift foxes are not found in large areas of Quay County because of intensive agricultural activities and unsuitable habitat, however, this gap always may have existed (Robert Harrison, The University of New Mexico, personal communication).

Research conducted by Rohwer and Kilgore (1973), Thorton and Creel (1975), and Mercure et al. (1993) noted the overlap of the swift fox's range with its close relative, the kit fox, in the Trans-Pecos region of New Mexico where the two species hybridize. Hubbard's report (1994) concluded that the hybrid zone between the swift fox and the kit fox "appeared to be restricted to an area not exceeding 50-60 miles in width in the Pecos Basin of New Mexico." Such hybridization makes identification of swift fox difficult in New Mexico.

North Dakota

Historically, the swift fox was distributed throughout most of North Dakota (Hall and Kelson 1959; USFWS 1990, Swift Fox Conservation Team 1997:46). An archeological record is recorded from On-A-Slant Village Site at Fort Lincoln State Park, Mandan. The first published record of the swift fox was in 1801 from Alexander Henry's fur shipment records, from Pembina Post of the Northwest Company's Red River District (Reid and Gannon 1928). The main post was located at the junction of the Pembina and Red rivers, with branch posts to the west in the Hair Hills (Pembina Hills) and the mouth of the Reed River in Canada. The small number (117) recorded in Henry's trapping records for an 8 year period suggests swift foxes were not common in northeastern North Dakota during Henry's operation at the Pembina Post (Reid and Gannon 1928). Bailey (1926) quotes Charles Cavileer from "A Story of '53" describing the fur-trade in Walhalla which is west of the Pembina Post. Cavileer reported 400-600 "kit foxes" obtained in one season at the Walhalla station for a period before the bison disappeared, but none had been seen since the bison disappeared. Henry considered bison very common on the plains during his time in North Dakota. In 1805, Lewis and Clark mentioned the Assiniboine Indians trading foxes 25 mi above the mouth of the Little Missouri river (Mountrail County; Bailey 1926).

Audubon reported swift foxes near Fort Clark in 1833 (in Bailey 1926), and again in 1843 (Audubon and Bachman 1854). In 1850, Culbertson collected a specimen near Fort Union (Bailey 1926). Hayden (1862 in Bailey 1926) reported capture of 50-100 swift foxes each winter near each of the trading posts along the Missouri River. Coues reported swift foxes as "common" along the Souris (Mouse) River (in Bailey 1926) and collect 5 specimens now located in the National Museum. In a report from an 1873 military expedition from Fort Rice (on the Missouri River near the geographic center of North Dakota) due west to and along the Musselshell River to the Yellowstone River, Allen (1874) described swift foxes as "quite frequent". Grinnell (1914, in Knowles et al. in press) found swift foxes abundant on the Little Missouri in 1874. Ludlow (1875) traveling from Fort Lincoln, (near present-day Mandan, North Dakota) to the Black Hills of South Dakota, described swift foxes as "abundant everywhere on the plains", though not often seen, on account of its small size and its disposition to hide when it can, in preference to running."

The last report of swift foxes in the northeastern region of North Dakota was a fox captured in 1876 by O. Dahal in Walsh County (Bailey 1926). Since the early 1900s, reports of the species have been limited to an area west and south of the Missouri River (one exception-see below). Visser (1914) reported a sighting from the Little Missouri river valley in Bowman County. Bailey (1926) reported swift foxes in Golden Valley, Morton, Ward, and Williams counties from 1900-1911. Bailey's (1926) last swift fox record came in 1915 from northern McKenzie County, where the species was considered rare.

Pfiefer and Hibbard (1970) reported one adult male swift fox in Slope County, North Dakota (Specimen Number 3013, North Dakota State University Museum). Since Pfeifer and Hibbard's 1970 record, three additional sightings have been confirmed. One sighting in 1976 was from Mercer County, and one in 1990 was from Golden Valley County (USFWS 1990).

These animals may have dispersed from a small population that existed in Perkins County, South Dakota. A swift fox was trapped in Ransom County, located in southeastern North Dakota in 1994 (S. Allen, North Dakota Game and Fish Department, personal communication 1999). It is difficult to even speculate on the source of this animal. A population in the area is unlikely. There is no additional evidence that swift foxes occur in the area despite surveys conducted by the North Dakota Game and Fish Department and the prevalence of trappers and hunters in the area who would encounter swift foxes if present. Annual progress reports of western predator abundance surveys conducted from 1972-1981 by the USFWS's Animal Damage Control Division did not detect the presence of the swift fox (Linhart 1972, 1973; Roughton 1974, 1975, 1976, 1977; Roughton and Sweeny 1978; Bean and Roughton 1979, 1980; Bean 1981). Presently, there are no known populations of swift fox in the state.

Oklahoma

In Oklahoma, the swift fox was considered to occur historically throughout the panhandle region (Cimarron, Texas, and Beaver counties) and western portions of three adjacent counties (Harper, Woodward, and Ellis counties; Duck and Fletcher 1945, Hall 1981, Caire et al. 1989). Reports from two early expeditions which reported observations of mammals, did not include presence of swift foxes, suggesting that swift foxes did not historically occur in other parts of Oklahoma. In the first expedition in 1835, Washington Irving joined a military expedition from Fort Gibson (northeast Oklahoma) to the center of the state. In his book "*A Tour of the Prairies*" (1835), Irving did not note the presence of swift foxes in his accounting of mammals. In 1852, Captain Randolph B. Marcy, explored the Red River, which defines the present southern border of Oklahoma. Marcy's list of mammals encountered did not include swift foxes (Marcy 1854).

Several agencies began biological exploration of the lands opened during the land runs of 1889 and 1893. Charles P. Rowley lead a party from the American Museum of Natural History that spent several weeks in October and November 1889 in the western part of the panhandle collecting bison. The party collected a number of small mammals near Corrupa and Seneca creeks in the southwestern part of present day Cimarron County, but they did not note swift foxes. Similarly, from the same period, collections in Wood County for the Field Museum of Natural History in Chicago, and in Woodward county for the U.S. Bureau of the Biological survey made no mention of swift foxes.

The first record of swift fox occurrence in Oklahoma was in 1888 located in the "Neutral Strip" (panhandle; Caire et al. 1989). Duck and Fletcher (1945) reported that "...in earlier days it [swift fox] was frequently seen throughout this area", but noted that they were "very rare" in 1945. Cockrum (1952) considered them extinct in the state. In 1955 Martin and Sternberg (1955) found one in Gove County. This was the first sighting in Oklahoma in over 50 years. Swift foxes were observed in Beaver, Cimarron, and Texas counties throughout the remaining 1950s and 1960s (Glass 1956, Cutter 1958a, Kilgore 1969, Caire et al. 1989). In the mid-1960s, Kilgore (1969) considered the swift fox abundant in the panhandle and noted an increasing availability of the species in Beaver County where he conducted his ecological study. Additionally, Kilgore (1969) indicated that habitat was rapidly decreasing due to the conversion

of native prairie to cropland in his Beaver County study area. Records of swift fox in Oklahoma ceased until a 1988 landowner survey, conducted by the Oklahoma Department of Wildlife Conservation, documented swift fox sightings throughout the panhandle (Hoagland 1995). Additionally, verified swift fox sightings by Oklahoma Department of Conservation biologists were reported in Cimarron, Texas, Beaver, and Roger Mills counties (Hoagland 1996).

Swift foxes were detected at 20 permanent scent stations on the Packsaddle Wildlife Management Area in Ellis County from 1993 to 1996 (Hoagland 1996). Prior tracks identified as swift fox from these stations could not be verified (Hoagland 1995). Surveys conducted by the Oklahoma Department of Wildlife Conservation in 1996 and 1997 confirmed the presence of swift foxes in the three panhandle counties (Cimarron, Texas, and Beaver) and in two (Ellis, Harper) of the four counties (also Roger Mills, Woodward) adjacent to the panhandle (Hoagland 1996, 1997, 1998). There was a sighting of a swift fox in Roger Mills County in 1994. These counties include most of the historical range (Swift Fox Conservation Team 1997).

Swift fox surveys in the three panhandle counties, conducted by the Oklahoma Natural Heritage Inventory, indicate that the largest swift fox populations occur in the western-most county in the panhandle, Cimarron, where agriculture is less intense and the landscape is dominated primarily by shortgrass prairie. Six of the seven counties in the historic range of swift foxes are considered to have habitat suitable for swift foxes (Swift Fox Conservation Team 1997).

South Dakota

All of South Dakota was historically considered as the range of the swift fox (Over and Churchill 1941, Hall and Kelson 1959, Egoscue 1979, Hall 1981), however, E. Birney, (Bell Museum of Natural History, University of Minnesota, pers. comm.), and J. Knox Jones (Texas Tech University) could find no record of swift foxes in the easternmost counties of South Dakota while researching for their 1988 book *Mammals of the North-Central States*. Archeological remains were found at the Mobridge site ca. 1650-1700 and the Walth Bay site ca 1550-1600, both in Walworth County (K. Lippincott, South Dakota Archeological Consultant). Perhaps the first published account of swift foxes is from Pierre-AntoineTabeau, a member of a fur trading expedition from St. Louis to the upper Missouri river from 1803-1805, who observed both red and "a kind of little gray fox" (presumably swift fox) as very common in the upper Missouri (in Abel 1939). Records of the American Fur Company's Upper Missouri Outfit (near the confluence of the Big Sioux and Missouri Rivers) from 1835-1838 noted 10,427 swift fox pelts compared to 1,051 red fox (*Vulpes vulpes*) pelts and 13 gray fox (*Urocyon cinereoargenteus*) pelts received during the same period (Johnson 1969). Ludlow (1875) reported swift foxes "abundant" on the plains while traveling from Fort Lincoln, ND through Corson and Harding counties, South Dakota, to the Black Hills. Visser (1914) described swift fox as present but very rare in Harding County, but noted that furbearer trapping reports were dependent on bounty prices. The Smithsonian records show a specimen collected northwest of Pierre, Hughes County, in 1917 (USNM 300300). This record is the easternmost historic record we could find for the state of South Dakota.

The fox collected in Hughs County in 1941 is also the last known occurrence in South Dakota for a 41-year period until 1958 when one was found near Morristown in Corson County (McDaniel 1975). A federal trapper caught one swift fox in western South Dakota in 1963 and another in 1965 (McDaniel 1975, Fox 1991). Additional records were reported in mid-1960s through the 1970s from Bennett, Butte, Corson, Fall River, Haaken, Perkins, Shannon, Spink, Stanley, Sully, and Tripp counties (Hawley 1974, McDaniel 1975, Van Ballenberghe 1975, Sharps 1977, Hillman and Sharps 1978, Uresk and Sharps 1986, Consolo 1987, South Dakota Natural Heritage Database 2000).

Records from the 1980s-1990s (see Appendix) include foxes in Fall River, Pennington, and Shannon counties (Consolo 1987, Hetlet 1991, 1995, 1998; Kruse et al. 1995; Dateo et al. 1996, Swift Fox Conservation Team 1996, Hetlet and Hodorff 1997, Carbyn 1998, South Dakota Natural Heritage Database 2000). Higgins et al. (2000) reports probable current distribution in Bennett, Custer, Fall River, Jackson, Pennington, Shannon, and Todd counties.

Surveys conducted by Buffalo Gap National Grasslands biologists indicate the swift fox population in Fall River County appears to be stable and swift foxes were observed in Pennington County (Hetlet 1995, 1998). Surveys conducted by South Dakota Game, Fish, and Parks in 1995 in Fall River (not in National Grasslands) and Shannon counties detected swift foxes in each county, but numbers seemed few (Kruse et al. 1995). Surveys of potential occupied habitat have not been completed and, although swift foxes have been recorded in 13 counties between 1963-1995 (Kruse et al. 1995, Hetlet 1995, 1996, 1998; Dateo et al. 1996; Althoff et al. 1997; Hetlet and Hodorff 1997; Zell et al. 1998), current distribution may be restricted to Fall River, Pennington, and Shannon counties, with possible population in Bennett County (Kruse et al. 1995, Swift Fox Conservation Team 1997:5).

The Turner Endangered Species Fund is initiating a reintroduction of swift foxes to the Turner owned Bad River ranch in Stanley and Jones counties southwest of Pierre. The Turner Endangered Species Fund, a division of Turner Enterprises, is actively implementing programs on Turner properties that concentrate on the conservation of imperiled species. In South Dakota, Turner owns the Bad River Ranch, on which swift fox restoration is one of the primary projects proposed. The reintroduction program is using the IUCN reintroduction criteria. Plans are to begin reintroducing foxes in 2000-2001.

Texas

There are fossil records from Scurry County (late-Pliocene) located within the recent historic range of swift foxes, and a mid-Holocene fossil record from Edwards County (Dalquest et al. 1969 in Jones et al. 1987). Bailey (1905) provided the first published report of swift fox in Texas, reporting foxes in Stanton, Martin, Midland, Oldham, and Armstrong counties. Bailey (1905) considered the swift fox to be more scarce than in prior years. A specimen from Armstrong County in 1905 (Bailey 1905) was the last recorded until mid-century, when one was collected in Swisher County in 1948 (Glass 1956). Cutter (1958a) indicated swift foxes to be reasonably common in Hansford County during the mid-century, and indicated they had

reoccupied many areas of the panhandle where they were once considered extinct. Esogue (1979) believes the population recovery occurred in the 1950s, and more specimens were obtained in the 1960s and 1970s.

Egoscue (1979), Hall (1981), and Jones et al. (1987) defined the historic range of the swift fox in Texas to include the panhandle region down into the west-central portion of the state; approximately 78 counties were included (Mote et al. 1998). Jones et al. (1987) indicated only 28 counties in Texas had reliable records of swift fox from the literature, trapping records, or museum specimens. Jones et al. (1987) estimated that half of the historic range of the swift fox (high plains below the 34th parallel) was no longer suitable for swift foxes due to intensive agriculture. Our accounting of historical and current records include swift foxes in 26 counties with another observation from the convergence of 3 counties: Crane, Pecos and Upton. Certainly foxes occurred in other counties lacking recorded observations or specimens, but the striking absence of records from the grassland type of Southern Mixed-Grass Prairie with Shrubs (Risser et al. 1981) suggests this shrubbed grassland habitat may be less suitable for foxes. Similar to the shifting nature of the boundary between mixed-grass and tall prairies described in the Introduction, encroachment of shrubs in the southern mixed-grass prairie (Archer 1994) may influence swift fox distribution.

A status review was conducted by the Texas Parks and Wildlife Department for the swift fox in 1987 because of concerns during the early 1980s over the rapid loss of native prairie habitat (Swepston 1981). Not all of the identified areas of potentially suitable habitat appeared to contain swift foxes (Jones et al. 1987, Mote et al. 1998).

Recent surveys of swift foxes began in 1996. Twenty-eight survey transects were conducted in 25 High Plains counties (Mote et al. 1998). Swift fox occurrence was documented in only two northwestern panhandle counties, Dallam and Sherman, using track plates and spotlighting in 1996; trapping and marking efforts in these two counties during 1997 resulted in 9 swift foxes captured with 7 of these marked and released. In 1998, 15 swift foxes were captured and radiomarked in Dallam County and spotlight surveys in Sherman County detected 1 fox observed per 3 miles. An incidental sighting of a swift fox was also confirmed by a state biologist in Lipscomb County north of the Canadian River in the extreme northeastern panhandle area where swift fox have not previously been documented (Mote et al. 1998). Most recently, Mote et al. (1998) estimated 25 counties contained sufficient quality and quantity of habitat to support swift foxes, but only three counties have verified reports in the past 10 years.

Presently, in Texas swift foxes are classified as a "furbearer," and harvest is allowed by regulation. Available harvest data suggests an annual harvest of 300 animals. The Texas Natural Heritage Program designates the swift fox as "very rare and local throughout its range, found locally in restricted range, or vulnerable to extinction throughout its range because of other factors" (The Nature Conservancy 1993). Two ecological studies of swift foxes are in progress in the panhandle region by Texas Parks and Wildlife and students at Texas Tech University.

Wyoming

In Wyoming, the range of the swift fox originally consisted of the shortgrass and mixed-grass region in the eastern half of the state (17 counties; Long 1965, Hall 1981, Lindberg 1986). By the late 1800s, swift fox numbers began a marked decline, and no reports existed from 1898 until a report from Laramie County in 1958 (Long 1965). Since that report, records suggest that some recolonization of vacant habitat in the eastern one-quarter of Wyoming has taken place (Linhart 1972, 1973; Roughton 1974, 1975, 1976, 1977; Roughton and Sweeny 1978; Bean and Roughton 1979, 1980; Bean 1981; Lindberg 1986; Bohne and Skinner 1989).

In 1995, Wyoming conducted a large-scale field survey of 12 counties covering eastern Wyoming (Woolley et al. 1995). Surveys included use of both scent-plates and spotlight surveys. The survey emphasized the peripheral areas of the historic range, yet swift foxes were detected in 9 (Albany, Carbon, Converse, Fremont, Goshen, Laramie, Natrona, Sweetwater, Weston) of the 12 counties (no observations in Campbell, Johnson, Sheridan). Trapper records (Lindberg 1986, Woolley et al. 1995) show that foxes may occur in an additional 2 counties (Lincoln, Park) west of the historic range as delineated by Long (1965).

Wyoming designates the swift fox as a nongame "protected species by Commission Regulation" (Swift Fox Conservation Team 1997), with incidental take allowed. The state believes the overall population is stable or expanding. The Wyoming Natural Diversity Data Base designates the swift fox as "imperiled because of rarity or because of factors demonstrably making a species vulnerable to extinction or rare or local throughout its range or found locally in a restricted range" (The Nature Conservancy 1999).

Canada

The swift fox was once a common species in the prairie region of Canada but by the 1930s it was considered extinct (Stewart 1974, Carbyn et al. 1994). Historical distribution of the species parallels the mixed-grass prairie regions of southwestern Manitoba, Saskatchewan, Alberta, and southeastern British Columbia (Egoscue 1979, Hall 1981). However, the inclusion of British Columbia is controversial because there are no records of swift foxes from this area (Egoscue 1979). The last confirmed records of swift foxes in Canada include a specimen taken in 1928 near Govenlock, Saskatchewan (Carbyn 1998). Since the 1930s, there have been very few reported sightings and no confirmed records of swift fox in Canada (not including recently reintroduced animals) (Looman 1972, Carbyn et al. 1994). This prompted the Committee on the Status of Endangered Wildlife in Canada to classify the species as extirpated in 1978 (Carbyn et al. 1994). Habitat within Canada's mixed-grass region has been greatly reduced. Eighty percent of the native grassland that once existed has disappeared, and much of the remaining grassland is altered (Carbyn et al. 1994).

A swift fox reintroduction program began in southern Alberta and Saskatchewan in 1983, with swift foxes released annually through 1998 (Brechtel et al. 1996). From 1983 to 1996, approximately 855 swift foxes consisting of captive bred animals and wild caught swift foxes from Colorado and Wyoming have been released in 3 areas along the Montana border. One

release site (Milk River, Alberta; 61 foxes released) was abandoned due to relative failure of swift fox survival (Cotterill 1997). The Canadian population estimate was approximately 289 foxes in 1996 (Cotterill 1997). Viability of these populations remains questionable due to the low number of established animals caused by high predation rates, continued modification of habitat, and unpredictability of climatic or other stochastic events on survival.

ESTIMATION OF HISTORIC AND CURRENT SWIFT FOX DISTRIBUTION

Historic—Using available information from literature, we have estimated historic distribution (prior to European settlement) of swift foxes in the United States. The estimated area of swift fox occurrence was completed state by state, based on the citations listed below but also considering historic records and habitat (shortgrass and mixed-grass prairies). We have calculated two estimates of historic distribution, a conservative estimate of 1,241,661 km² and a more liberal interpretation of literature resulting in an estimate of 1,594,994 km² (Fig. 2). Large forested and montane areas within the short grass and mixed-grass prairies are not included in the calculations, however, many smaller areas (e.g., see Hoffmann and Jones 1970:358) remain in the calculation of areas. Additionally we have include a Figure 3 which provides the year of the most recent record (published, museum, state agency records, etc.) of a swift fox observation by county.

Sources used to define historic distribution of swift foxes:

Colorado

Conservative estimate: Extent of the shortgrass prairie (Risser et al. 1981)

Liberal estimate: Counties identified by Armstrong (1972)

Kansas

Conservative estimate: Zumbaugh and Choate (1985), Choate (1992), Fox and Roy (1995)

Liberal estimate: Extent of the shortgrass and mixed-grass prairie (Risser et al. 1981)

Montana

Conservative estimate: Extent of mixed-grass prairie and much of the bunch grass steppe (Risser et al. 1981, with consideration of the historical records and eliminating larger forested areas and mountain ranges), Swift Fox

Conservation Team (1997), Knowles et al. in press.

Liberal estimate: Extent of mixed-grass prairie and much of the bunch grass steppe, Swift Fox Conservation Team (1997), Knowles et al. in press

Nebraska

Conservative estimate: Extent of shortgrass and mixed-grass prairie (Risser et al. 1981)

Liberal estimate: Jones (1964)

New Mexico

Conservative estimate: Extent of shortgrass prairie (Risser et al. 1981)

- Liberal estimate: Swift Fox Conservation Team (1997; county lines)
- North Dakota
 - Conservative estimate: Extent of mixed-grass prairie (Risser et al. 1981)
 - Liberal estimate: Egoscue 1979
- Oklahoma
 - Conservative estimate: Swift Fox Conservation Team (1997, 7 counties)
 - Liberal estimate: Extent of shortgrass and mixed-grass prairie (Risser et al. 1981)
- South Dakota
 - Conservative estimate: Extent of mixed-grass prairie (Risser et al. 1981)
 - Liberal estimate: Egoscue 1979
- Texas
 - Conservative estimate: Modification of both Mote et al. (1998, 78 counties) and extent of shortgrass and mixed grass prairie
 - Liberal estimate: Mote et al. (1998, 78 counties)
- Wyoming
 - Conservative estimate: Conservative combination of Long (1965), Lindberg (1986), and extent of mixed-grass prairie and bunch grass steppe (Risser et al. 1981)
 - Liberal estimate: Liberal combination of Long (1965), Lindberg (1986), and extent of mixed-grass prairie and bunch grass steppe (Risser et al. 1981)

Current distribution—We calculated estimates of the area of swift fox distribution using records of occurrence by county for 1990 to 2000 and 1995 to 2000 (Fig. 4). We did not fill gaps between counties with records. Total area of counties with swift fox records from 1990 to 2000 is 712,895 km² and from 1995 to 2000 is 674,407 km². It is important not to interpret this as a reduction in area occupied by swift foxes because this is an area generated by totaling the entire area of each county with a record, not excluding areas each county with habitat that not suitable (mountains, etc.). If we include only area of individual counties with records from 1995 and later, and within our Conservative estimate of swift fox historic range, the resulting area is 505,149 km² (Fig. 5). Using these estimates, the proportion of the Conservative Historic Range with swift foxes by county is 41%. If we include only area of individual counties with records from 1995 and later, and within our Liberal estimate of Swift fox historic Range, the resulting area is 607,767 km². Using these estimates, the proportion of the Liberal Historic Range with swift foxes by county is 38%. Both of these proportions may be underestimates of the proportion of the historic range which is now occupied because we did not include those counties without records which were adjacent to counties with records of swift fox occurrence (i.e., we did not fill in any gaps).

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